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ABSTRACT

The central objective of this study was to determine the effects of formal training in the use and types of questions and in the nature and use of algorithms on middle school students' achievement in economic geography. Subjects were 190 eighth grade students in a large metropolitan school district. Three experimental groups received either: (1) packets of materials dealing with algorithms and questions; (2) packets on algorithms; or (3) packets on questions. After reacting to the experimental material and economic geography packet, all subjects took an achievement posttest developed by the investigator. The results indicated that students who received training in algorithms differed significantly from students who lacked such training. However, students who had training in algorithms did significantly less well than those students who received training only in questions or did not receive any training at all. The results do not suggest that algorithm training and question training are significantly more beneficial to student achievement than regular teaching, but the benefit may be found in other qualities such as an increased awareness of knowledge production, rather than in the dependent variable of achievement. (PN)

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THE IMPACT ON STUDENTS' SOCIAL STUDIES ACHIEVEMENT OF STUDENTS' USE OF QUESTIONS AND ALGORITHMS

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THE IMPACT ON STUDENTS' SOCIAL STUDIES ACHIEVEMENT OF STUDENTS' USE OF QUESTIONS AND ALGORITHMS

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Introduction

In the last two decades there has been much research on the impact of questions on students' achievement and thinking. Much of the research has addressed teacher's questions. Coming from this research have been suggested ways for teachers to improve their questioning. Gega, 1977; Hunkins, 1972; and Hyman, 1979 have written extensively on ways to get teachers to employ questions in the classroom. The message implicit in the research and the various writings on questions has been that it is right for teachers to be the question askers and for pupils to be the question answerers.

But much of the research on teachers questions has produced a mixed picture as to the effectiveness of using particular types of questions to elicit from students higher levels of achievement and/or thinking. Researchers such as Rosenshine, (1976) are noting that teacher's use of high cognitive levels questions is not more effective than the use of lower cognitive level questions (knowledge and comprehension) when looking at the variable of student achievement. Others (Hunkins, 1969; Gall, 1978; Pressley, 1985) have noted that the use of questions at the upper cognitive levels does significantly impact achievement in a positive fashion.

While it is still important to research the teacher's questions within the classroom framework, some researchers have centered their attention on student's questions--specifically their generation of questions. Frase and Schwartz (1975) investigated in two studies whether student generated questions aid learning. The first experiment, which involved 64 high school seniors and juniors reacting to a biographical text revealed that subjects who were involved in asking questions and responding to them scored significantly higher on a recall test than subjects who received no questions at all. In the second experiment, 64 college freshmen were assigned to one of two groups: a question generating group or a study group. The subjects in the questions generating group were instructed to formulate either five or ten questions at two different levels: questions about easy facts and those about hard-to-remember facts. The question-generation group's performance when compared to the study group revealed significant differences. The researchers stated that the results suggest that engaging in question producing facilitates recall over just studying.

Ross and Killey (1977) also have examined the effects of self-generated questions on retention. While they worked with fourth graders, their results supported the hypothesis that information obtained through the subject's own questions proved significantly better than information acquired by another--in this case a student's partner.

But such research has also produced results in which students who generated their own questions did not perform significantly better than students who did not receive such opportunity (Bernstein, 1973; Morse, 1975; Owens, 1976).

The mixed results may be due to the fact that even when students were allowed to generate their own questions, they were not furnished any guidance as to the type or level of questions to be generated nor how much questions might be ordered in some type of strategy or routine. Students lacked training in questions and strategy formation.

But, some research has been done in the last ten or so years on training students in questioning. Andre and Anderson (1978-79) conducted two experiments in which high school seniors were trained in questions and questioning. The results led the investigators to conclude that subjects can be trained in the skill of generating main-point questions and the training procedure appears effective in increasing student's ability to generate good questions.

Singer and Donlan (1982) also focused on investigating whether readers, through direct instruction in how to pose questions about a story, could also acquire the ability to use their knowledge about stories to focus on specific information in a particular story. They worked with high school juniors and their results seem to suggest that if training occurs over a period of time, then students will do significantly better on quizzes dealing with material read. Cohen (1983), working with third graders, also found that significant gains on standardized

tests as well as on a criterion test dealing with the area of reading were attained by students trained in question asking. But the results are still mixed. Wyman (1984) working in social studies with sixth graders found no significant effect on achievement of students trained in questions.

Another area of research that has appeared over the last ten or so years focuses on having students use particular formalized strategies, algorithms, (Landa, 1974) and to become aware of the procedure or procedures they are employing in their learning, metacognition, (Masson, 1982). Strategies have been identified as intentional plans or actions that are engaged in for particular cognitive goals (Brown, 1978; Flavell, 1970). Strategies entail basic cognitive processed organized in particularized ways (Borkowski and Buchel, 1983). What makes attention to these strategies important is that attention is given to what knowledge a learner must have about the strategy, its value, its range of applicability, and the manner of its execution. Pressley (1985) refers to this strategic knowledge as specific knowledge.

It seems to this investigator that one reason for the lack of a totally convincing case regarding the effectiveness of the use of questions at various levels may lie in the fact that most researchers dealing with questions have neglected to teach students about the nature of questions, and how questions can be placed into particular strategies or routines, which Landa calls algorithms. Futhermore, in many cases we really have not directly taught to students an awareness of these strategies. As

Pressley notes, we have not taught meta-strategies and metacognitive acquisition procedures (1985). This current study was an exploratory attempt to fill in some of these gaps by directly training students in question generation and in a routine they could employ.

METHOD

Objective

The central objective of this study was to determine the effects of formal training in the use and types of quetions and in the nature and use of algorithms on middle school students' achievement in economic geography.

The main research questions addressed were:

1. Will middle school students who receive formal training via packet materials on the nature and purpose of questions and the nature and purpose of algorithms achieve significantly better in social studies content than students who do not recieve such training via these materials?
2. Will middle school students who receive formal training via packet materials on the nature and purpose of questions and the nature and purpose of algorithms achieve significantly better in social studies than students who receive only training in questions and questioning?
3. Will middle school students who receive formal training via packet materials on the nature and purpose of questions and the nature and purpose of algorithms

achieve significantly better in social studies content than students who receive only training in algorithms?

Participants

Participants were 190 middle school students (eighth grade) in a large metropolitan school district. Students were randomly selected by class into three experimental groups and one control group. Experimental group 1 received an investigator-prepared packet on questions and one on algorithms; experimental group 2 received only the packet on algorithms; experimental group 3 received only the packet on questions. The control group, group 4, did not receive any packet. While intact classes in three schools were used because the investigation was not permitted to randomly assign individual students to treatments, there were no reasons to assume that these classes were not similar in student composition regarding abilities and characteristics. Students, as far as the investigator could determine, were assigned to their various classes on a random basis. Midway through the investigation, one teacher who had one class in experimental group 1 withdrew. This drop, while changing the number of subjects receiving treatment 1 (algorithms and questions) did not produce difficulty for the analysis considered unequal n's.

Materials

The materials for the investigation consisted on one packet dealing with questions. This packet informed the reader of the nature and types of questions (Bloon's categories) and had activities where students could write different types of questions. Another packet treated algorithms, discussing their

nature and presented several examples. This packet led students through a particular algorithm they could use when reacting to written material.

An information packet dealing with economic geography was prepared for all groups. Information in this packet was drawn from a world geography textbook written by the investigator.

The investigator prepared lesson plan materials for the teachers to use when dealing with the various packets of students/material. These lesson plans had the teachers keep their instructional presentations of packet materials identical.

The investigator also developed a 46 item objective achievement test relating to the economic geography material.

The California Achievement Test, reading section, furnished total reading scores on the total sample.

Procedure

The experimental groups read and reacted to their particular packet material or materials under the guidance of the regular teachers. After the experimental packets were processed--2 days for the question packet, 3 days for the algorithm packet, and 5 days for both, these subjects as well as the control subjects spent four days reacting to an information packet on economic geography. Their regular teachers taught this material closely following a lesson-instruction plan developed by the investigator to keep constant teacher method, content, and time spent. Teachers in each experimental group were instructed to have their students employ what they had learned in their processing of the experimental packet or packets, when processing the material on

economic geography. The control group received no such directions, but did process the economic material in the same manner as subjects in the experimental groups. All teachers followed the same lesson plan for dealing with the economic geography material.

After reacting to the economic geography packet material, all subjects took an achievement posttest developed by the investigator.

Results

The research design employed was a 2 X 2 randomized groups design with Analysis of Variance as the major analytical tool. Table 1 reports the means and sample size of the four groups, three experimental and one control.

Table 1

Means for Scores on Achievement Posttest

	$\bar{X}$	Sample size
Group 1 (Question and Algorithms)	29.74	31
Group 2 (Algorithms)	30.91	45
Group 3 (Questions)	32.60	52
Group 4 (Control, no ques/algor.)	32.96	56

*6 cases missing due to an incomplete data.

To determine whether the means of the treatment conditions and the control group on the total posttest differed significantly, an analysis of variance was performed.

The results of this analysis are reported in Table 2.

Table 2

Analysis of Variance of Posttest Achievement Scores

Source of Variation	Sum of Squares	df.	Mean Square	F	Sig. of F
Main effects	268.68	2	134.34	2.58	.079
Algorithms	256.39	1	256.39	4.92	.028
Questions	21.74	1	21.74	.42	.519
2-way interactions	7.01	1	7.01	.14	.741
algor/quest.	7.01	1	7.01	.14	.741
Explained	275.69	3	91.89	1.76	.156
Residual	9376.03	180	52.90		
Total	9651.72	183	52.74		

As may be observed, the main effects were non-significant. But algorithms taken alone did produce a significant effect. Questions by themselves did not have a significant effect. In fact, the results were at the level of chance. Neither was there a significant interaction between algorithms and questions.

When looking at the means of those students who just had algorithms or algorithms and questions, we find that training students in the nature and use of algorithms actually caused the students to perform less well on the posttest achievement test compared to students who just received training in questions or no training at all, (see table 1). While algorithms have a

significant effect, it appears that the effect is negative regarding achievement.

The results show that training students in the use of questions did not produce a significant effect when the total posttest score was used as the dependent variable. Students who received training in questions did not perform significantly better on the total posttest than students who received no training.

The non-significant interaction indicates that training in questions did not effect in anyway students' performance on algorithms or vice versa. The two treatments did not impact each other.

Since the materials used in the investigation required students to read packet materials, the investigator wished to analyze the data using students' total reading score on the California Achievement test as a covariate. Employing this score as a covariate in re-analyzing the data gained from administering the achievement posttest did not produce any change at all in the results.

Discussion

This exploratory research was concerned with the efficacy of training students in the use of questions and algorithms in regard to achievement. The investigator from analysis of previous studies on training on questions and work on algorithms plus work on metacognition felt that this study would furnish evidence that students who received training in both algorithms

and questions would do better on an achievement test than students who just received training in either algorithms or questions, or no training at all.

The results did indicate that students who received training in algorithms did significantly differ from students who lacked such training. This would be encouraging if the difference was in greater achievement scores. However, students who experienced training in algorithms actually did significantly less well than students who just received training in questions or did not receive any training at all.

That training in algorithms actually produced a significant depresssion on achievement test scores is a bit difficult to explain, but certainly of high interest. An initial explanation is that students found the material on algorithms too foreign to their experiences. Algorithms are not encountered in a daily fashion in most schools. It is possible that the students considered the material too much of a "jump" from their regular classroom work and thus were "put off" by the material. It could be that even the teachers who were using the packets found the material too far from mainstream educational material. Teachers, even though requested to follow closely the lesson plans provided, may in fact have sent out messages to students that this material on algorithms was indeed difficult and foreign.

All of this, the newness of the concept of algorithms, a possible negative attitude of teachers, might have caused those students who had this material to actually "lose heart" with the

material--to give up--to say, "I cannot do this," which in fact became the case.

Perhaps students at this age are just not capable of using algorithms. It may be that students have been taught memory games to apply, but have not been given sufficient time to actually apply information processing strategies to information. It could be that in order to become skilled in using algorithms more than three days, the time alloted in the experiment, are necessary.

There may be other reasons why students did significantly less well when exposed to algorithms. A replication of the study seems necessary to determine these reasons.

If algorithms are less well known to students, certainly questions are not. Why did training in questions not produce a significant effect on achievement? Perhaps the reason that students trained in questions did not perform significantly better on the posttest than students who did not receive such training is due to the fact that the questions in the packet were at both low level and high level. Students in most classes, so the research supports, really experience a majority of low-level or knowledge questions. But the packet on questions asked students to go beyond--to think of questions at upper cognitive levels. Students might have found this also too much of a change for them to accept. Students wished to stay perhaps with low-level questions or questions dealing with literal interpretation. It may be that the reason that students in the control group did just as well as those in the question training group was that the

teacher, while she did not have students trained in questions, could most likely have engaged in asking specific knowledge questions about the economic geography material. Thus, even though these students were not trained in question asking, they did experience teacher questions. Also, students in the experimental group may have just focused on the comfortable low-level questions in the packet and the teacher of this group may also have asked primarily knowledge-level questions in class.

It should be pointed out that no group did outstandingly well on the achievement test. This may be due to the students realizing that this was not a regular part of their curriculum, even though teachers were free to make it so. The content of the packet on economic geography may not have been of high interest to these students, thus depressing scores.

If we assume that the content was difficult and not of high interest, and that the students realized that this was not a part of the regular curriculum, we perhaps have an explanation as to why the scores were not that high on the achievement posttest. Perhaps had the experiment gone on for a longer period of time, results might have been different. One might argue that the reading level of the packets was difficult. But the material had been checked for readibility and found appropriate. Also, reading when used as a covariate did not indicate different results.

One explanation for the results might be that students were not used to working with packets independently. Had students

been allowed to work with a class peer and engage in discussion of the material, the results might have been different. Further investigations will be needed to answer this question.

The results do not suggest that algorithm training and question training are significantly more beneficial to students' achievement than just "regular" teaching. But, perhaps the benefit is not to be found in the dependent variable of achievement. Perhaps the benefit comes from an increased awareness of knowledge production, a tolerance of ambiguity, a development of perserverance, and a richer understanding of material. These were not investigated in this exploratory study, but certainly could in another investigation. Perhaps we can assume that with regard to achievement, direct teaching is just as good as having students raise questions or be systematic in their approach to information.

It may be that we need in a later investigation to see if students who are trained in algorithms and/or questions raise different types of questions and put those questions into more complicated strategies than do students who do not receive such training. Certainly, this investigator wants to determine if a similar population involved in the same type of experiment will react in the same way.

References

M. Andre and T. H. Anderson. "The Development and Evaluation of a Self-Questioning Technique". Reading Research Quarterly. 1978-79, 14, 4, 605-632.

B. S. Bernstein, "The Effects of Children's questions - Asking Behavior on Problem Solution and Comprehension of Written Material." (Doctoral Dissertation, Columbia University, 1973). Dissertation Abstracts International 34, 3219A-3130A.

J. G. Borkowski and F. P. Buchel, "Learning and Memory Strategies in the Mentally Retarded," in M. Pressley and J. R. Levin eds. Cognitive Strategy Research: Psychological Foundations New York: Spinger-Verlag, 1983.

A. L. Brown, "Knowing When, Where and How to Remember: A Problem of Metacognition." in R. Glaser, ed. Advances in Instructional Psychology.. Hillsdale, N.J. Lawrence Erlbaum Associates, 1978.

R. Cohen. "Self-generated Questions as an aid to Reading Comprehension." The Reading Teacher, 1983, 36, 8, 770-775.

J. H. Flavell, "The Development of Mediated Memory." in H. W. Reese & L. P. Lipsitt (eds. Advances in Child Development and Behavior (Vol. 5). New York: Academic Press, 1970).

L. T. Frase and B. J. Schwartz, "Effect of Question Production and Answering on Prose Recall." Journal of Educational Psychology, 1975, 67, 628-636.

M. Gall, et. al. "Effects of Questioning Techniques and Recitation on Student Listening," American Educational Research Journal, 1978, 15, 175-199.

P. C. Gega, Science in Elementary Education. New York: John Wiley & Sons, 1977.

F. P. Hunkins, "The Influence of Analysis and Evaluation Questions on Achievement and Critical Thinking in Sixth Grade Social Studies", Final Report, U.S. Department of Health, Education, and Welfare, 1968.

F. P. Hunkins, Questioning Strategies and Techniques. Boston: Allyn and Bacon, Inc. 1972.

R. Hyman, Strategic Questioning. Englewood Cliffs, N.J. Prentice-Hall, Inc., 1979.

Landa, Algorithmization in Learning and Instruction, Englewood Cliffs, N.J. Educational Technology Publications, 1974.

M. Masson, "A Framework of Cognitive and Metacognitive Determinants of Reading Skills," in Metacognition and Learning Disabilities. Ed. Bernice Y. L. Wong. Aspen Systems Corp., 1982.

J. M. Morse, "Effect of Reader-generated questions on Learning from Prose." (Doctoral Dissertation, Rutgers University, 1975), Dissertation Abstracts International 36, 6636A-6637A.

A. M. Owens, "The Effects of Question Generation, Question Answering, and Reading on Prose Learning." (Doctoral Dissertation, University of Oregon, 1976). Dissertation Abstract International, 37, 5709A-5710A.

M. Pressley and D. Pressley, "Questions and Children's Cognitive Processing," in A. Graesser and J. Black, The Psychology of Questions Hillsdale, N.J. Lawrence Erlbaum Associates, Publishers, 1985.

B. Rosenshine, "Classroom Instruction," in Gage, N.L. ed. The Psychology of Teaching Methods. Chicago: Yearbook of the National Society for the Study of Education, 1976.

H. Ross, and J. C. Killey, "The Effect of Questions on Retention," Child Development, 1977, 48, 312-314.

H. Singer and D. Donlan, "Active Comprehension: Problem-Solving Schema with Question Generation for Comprehension of Complex Short Stories." Reading Research Quarterly, 1982, 17, 2, 166-186.

R. M. Wyman, "The Effects on Question Training and Generation of Adjunct Postquestions on Sixth-Graders' Comprehension and Retention of Social Studies Text," Dissertation. University of Washington, 1984.